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Technicians & Nurses Program

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Update on Modern
Corneal Surgery:
The Technician’s
Role

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QUIZ 1

• What is the # 1 indication for Corneal
  Transplant Surgery
  –A) Corneal Scarring
  –B) Keratoconus
  –C) Fuch’s Corneal Dystrophy
  –D) Pseudophakic Bullous Keratopathy
QUIZ 2

• Corneal Transplant patients typically use these drops for an extended period of time
  – A) Topical antibiotics (Vigamox)
  – B) Topical NSAIDS (Ketorolac)
  – C) Topical Beta Blockers
  – D) Topical Steroids

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• If topical steroid drops are discontinued, the patient would be most likely to experience this adverse event:
  – A) Corneal Graft Rejection
  – B) Corneal Graft Infection
  – C) Irreversible failure of the Corneal Graft
  – D) Expulsive Choroidal Hemorrhage
Quiz 9

• Durezol is a potent topical steroid that can cause steroid responsive glaucoma
  – A) True
  – B) False

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• Corneal graft rejection increases the risk of failure of future corneal grafts
  • A) True
  • B) False
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• A red painful eye or an eye with new onset blurred vision in a patient with a history of corneal transplant should receive urgent evaluation
  – A) True
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• Patients with history of Penetrating Keratoplasty are at risk of open globe injuries following blunt ocular trauma for the rest of their lives.
  – A) True
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• Selective suture removal can be used as a method for reduction of post-operative astigmatism starting at 3 months after penetrating keratoplasty (PK).
  –A) True
  –B) False

QUIZ 8

• Corneal topography can be used as a guide in selective suture removal following penetrating keratoplasty (PK)
  –A) True
  –B) False
What is a corneal transplant / keratoplasty?

- Wiki:
  - a surgical procedure
  - damaged or diseased cornea* replaced
  - donated corneal tissue (the graft)
    - in its entirety (penetrating keratoplasty)
    - or in part (lamellar keratoplasty).

*Cornea (K): the transparent front part of the eye that covers the iris, pupil and anterior chamber.

Cornea: Basic dimensions: average diameter 11.5mm horizontal, 10.5 mm vertical, thickness .55mm (550um) centrally, .7mm (700um) peripherally
The Cornea is Lamellar

5 Layers: Epithelium, Bowman's membrane, Stroma (90% of K thickness, 20% collagen, 80% water), Descemet's Endothelial Basement Membrane, Endothelium (single layer of cells that maintain fluid balance in the corneal stroma)

Corneal stromal collagen form 300-500 lamellae or layers that are very interconnected in the anterior 1/3 of the stroma. The posterior stromal layers span limbus to limbus without antero-posterior interconnections and form horizontally interconnected sheets of collagen that are 1 to 2.5 um thick.

Types of Corneal Transplants

• “Penetrating”(Full Thickness) Keratoplasty
• “Lamellar” Keratoplasty
• Anterior Lamellar Keratoplasty
• Endothelial Keratoplasty
What are the Indications for Corneal Transplant?

- Tectonic - repairing perforations
- Therapeutic - eradicating infections
- Optical - improving vision

So what are the indication for corneal transplant surgery?…

Perforated Fungal Ulcer

Chronic fungal infections can be very resistant to treatment and lead to eventual tissue perforation.
Advanced cases of PBK develop corneal bullae or blisters which can burst and cause significant pain in addition to the blurry vision.

Fuch’s Endothelial Corneal Dystrophy (FECD)

A similar condition can also be inherited where endothelial cell drop out is much more rapid compared with the general population and leads to corneal swelling.
Specular microscopy uses a microscope to analyze and image the mosaic of hexagonal endothelial cells for abnormality in number, size, and shape and for detection of large areas of endothelial cell loss and accumulation of proteinaceous debris called guttata.
Advanced Keratoconus (KCN)

Keratoconus is a disease, linked to eye rubbing and allergic or atopic disease and leads to gradual corneal warpage with severe corneal steepening and astigmatism to the point where the cornea becomes conical. As D’s is stretched during this process it can break leading to an inrush of fluid into the corneal stroma with sudden massive swelling termed hydrops as pictured in the bottom.

Corneal Transplantation (Full Thickness / Penetrating)

Corneal transplants may be full thickness and replace the entire cornea in one operation…
The posterior layer of the cornea may also be selectively removed...more easily than the anterior layers. The posterior most layer of the cornea actually easily peels off in one continuous sheet. This sheet is Descemet’s membrane, which serves as a basement membrane or resting place for the endothelial fluid pumping cells of the cornea.

Once the D’s layer has been removed, it can be replaced by donor tissue, which initially, is held in position by a large air bubble filling the anterior chamber.
Transplants may also remove selective layers of the cornea. This diagram shows the anterior layers or lamellae being lifted up and carefully dissected off.

Here are some real life photos of an anterior lamellar dissection after air has been injected as seen in pictures 1a and 1b. The air injection was done to separate deeper layers of the cornea from one another and the anterior layers are dissected/peeled away.
Disadvantages of Lamellar Surgery

- Complications secondary to surgical learning curve for newer techniques
  - DSEK
  - DALK
- Longer and more tedious with lower reimbursement
  - DALK

The disadvantages of lamellar surgery are fewer in number.

Advantages of Lamellar Surgery

- Less Invasive (all)
- Greater Postoperative Stability of Tissues (all)
- Reduced incidence of graft rejection (all)
- Smoother surface contour with less astigmatism (DSEK)
- Faster Surgical Time (DSEK)
- Faster recovery (DSEK)
- Improved uncorrected visual acuity (DSEK)

Advantages of lamellar surgery are listed here.
Here is a completed full thickness transplant with sutures in place within the first several weeks post-op.

**Keratoprosthesis**

- Artificial cornea made from clear plastic
  - Excellent tissue tolerance and optical properties
  - Typically used in patients at high risk for donor graft failure
    - Multiple prior failed PK's
    - Multiple episodes of graft rejection
  - Risk of extrusion and

Artificial corneas are also available and are used in few select cases where the likelihood of failure of traditional transplants is deemed to be unacceptably high. While these can greatly benefit a select group of patients, they have many downsides and are lifelong projects to maintain. Patients have to wear a soft contact lens for the rest of their lives to provide the necessary surface smoothness and lubrication and are thus on a topical antibiotic for the rest of their lives. The incidence of difficult to treat glaucoma is almost 100% and the majority of the patients must have a glaucoma tube shunt to keep the IOP acceptable. Also get retrocorneal membranes can be difficult to treat and if not carefully managed, these artificial tissues can extrude leading to loss of the eye.
DSAEK immediately post-op

DSAEK 1 day post-op
Corneal Transplants: Early Post-Op

• **Take interval history**
  – What was the surgery and what was the reason for it?
  – Ask about pain (throbbing vs foreign body sensation)
    » presence of headache
    » nausea / vomiting
    » discharge / bleeding
    » Pain / symptom relief
Corneal Transplants: Early Post-Op

– Carefully record all medications
  • Antibiotic drops and / or oral
  • Steroid drops and / or oral
  • Nonsteroidal Anti-inflammatories (NSAIDS)
  • Ointments
  • Pain medications
– Ask if the patient is aware if a contact lens (bandage) was placed after surgery

Corneal Transplants: Early Post-Op

• Assess level of vision
  – Limited vision screening
  – Remove patch or shield
  – Check vision by waving hand, showing fingers, showing big letters on eye chart
• make a general assessment based on appearance of patient and eye
• no refraction, keratometry, or other testing
• ask surgeon if he needs any instrumentation in exam room
Clear PK sutures out

Here is a full thickness transplant over a year post-op where all sutures have been removed and the graft is clear.

Corneal Transplants:
Months to Years Out

- Record **Chief Complaint**
- Take interval **ocular history**
- Record changes in general **medical history**
- Record all **medications** patient taking
- Confirm patient taking **topical steroids** and if not, why not?
Topical Corticosteroids

- Local vs Systemic Immunosuppressive Therapy
- Used to suppress inflammation locally and prevent graft rejection
  - Must not be stopped prematurely
- Low systemic side effect profile
- Significant ocular side effects
  - Steroid response glaucoma
    - Especially Durezol
  - Increased susceptibility to infection
  - Cataract
  - Steroid dependence

Topical corticosteroids have a much lower side effect profile compared with systemic steroids, are effective in preventing and reversing episodes of corneal graft rejection but do have a significant ocular side effect profile that must be carefully monitored.

How are corneal transplant recipients different from recipients of other tissue transplants?

- Ocular immune sequestration
- Minimum requirement for immunosuppressive therapy
- Topical corticosteroid drops only, in most cases
- Topical corticosteroids must be used long term (≥ 5 yrs)

Corneal transplants differ from many other kinds of tissue transplants in that rejection of the graft is a less common and less problematic occurrence. Rejection is most often successful prevented and treated with the use of topical steroid drops used for an indefinite period of time.
Ocular Immune Privilege or Why is the cornea so special?

- Immune response
  - Requires trigger from foreign antigen
  - “Trigger” travels via lymphatics to lymph node
- Interior of the eye is devoid of lymphatics and lymphoid cells
- Cornea normally devoid of vasculature (transparent)
  - Closest lymphoid cells in conjunctiva
  - Difficult for immune cells to quickly get to the cornea and difficult to get a corneal foreign antigen to conjunctival lymphatics and regional lymph nodes.
- Immune responses in the cornea are delayed and weak
- immune privileged sites: tissue grafts can survive for extended periods without rejection

The cornea is considered an immune privileged site. While immunologic rejection can and does occur, it is much less of a problem compared with transplants of highly vascularized organs or tissues such as kidneys or livers. It typically occurs months to years after transplant and is relatively easily suppressed and reversed with topical steroids drops. Basically the foreign tissue must be recognized by cells from the bloodstream. These cells must then deliver the foreign material to a lymph node via lymphatic vessels for an immune response to occur. The cornea normally lacks blood vessels and so cells cannot quickly or easily get there to get the foreign material and then get back to the conjunctival lymphatics, so immune responses are delayed and very weak. Thus, this tissue is considered “immune privileged” and tissue grafts can survive for long periods or indefinitely without rejection in some cases.

Steroids in Ophthalmology

- Strong Steroids: Durezol
- Medium Steroids: Prednisolone 1%
- Weak Steroids: Lotemax, FML, Alrex, Prednisolone 0.1%
- Steroid Injections
  - Kenalog / Triamcinolone
  - Decadron / Dexamethasone
- Oral steroids
  - Prednisone
  - Medrol dose pack
Corneal Transplants: Months to Years Out

- Confirm **refractive eye wear** (glasses or contacts) and whether present at exam
- If present, confirm and document **refractive correction**
- **Assess and record vision** with and without refractive correction
- Compare corrected visual acuity with last recorded visual acuity
- Decide on whether patient needs new manifest refraction or whether an accurate manifest refraction may even be possible.

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Corneal Transplants: Months to Years Out

- **Assess pupils**
  - are they both equal and reactive?
  - Is there a fixed and dilated pupil?
  - Presence of a RAPD?
- **Assess confrontation visual fields**
  - Are there any gross VF defects that could explain vision or reported visual symptoms?
- Make a **general assessment** of appearance of patient and patient’s eyes
  - Do they look “white and quiet” or does either one or both eyes appear to be inflammed (redness, discharge, light sensitivity)
- If significant **interval worsening**, ask physician if he wishes to dilate
- Take automated and / or manual keratometry
- Perform automated and / or **manifest refraction**
Corneal Transplants: Months to Years Out

• To Refract or Not?
  • Is documented visual acuity worse or is patient complaining of vision becoming more blurry or that they want new glasses or contacts?
  • Review patient history and corneal testing
  • evidence of patient cooperation
  • surface regularity or lack of
  • evidence of healthy endothelial cells?
  • corneal edema?
  • assess patients pupils and CVF
  • Did visual acuity improve with pin hole?

• Perform and / or gather all corneal testing (topography, cell counts)
  • Corneal Topography
Topography

- Placido based technology
- Information about
  - Surface regularity / irregularity
  - Amount and location of both regular and irregular astigmatism
  - Potential visual acuity based on ocular surface
  - Can serve as a guide to selective suture removal

Tomography / Galilei

- Anterior & Posterior surface curvature
- Thickness map
- Presence of posterior protrusion
- Identifies higher order aberrations
  - Detract from visual quality as a result of corneal shape factors or surface disease
Manual Keratometry

- Often neglected test
- Gives info regarding image quality
- Ocular surface health
- Tear film stability
- Tells power and axis of astigmatism
- Guide to selective suture removal

Specular Microscopy

- What is normal endothelial cell count?
  - 40yo: ~3000 cells/mm²
  - 70-80yo: ~2000 cells/mm²

Specular microscopy uses a microscope to analyze and image the mosaic of hexagonal endothelial cells for abnormality in number, size, and shape and for detection of large areas of endothelial cell loss and accumulation of proteinaceous debris called guttata.
Anterior Segment OCT

- Average normal corneal thickness?
  - ~540um (~1/2 mm)

- What thickness usually implies abnormality?
  - >650um highly suspicious for corneal edema
  - <400um highly suspicious for ectatic disorder such as keratoconus or severe tissue loss from ulceration

Tips on refracting

- Use **autorefractor** if reliable
- Start with astigmatism from manual K’s and topography and gradually dial in more minus
- Use big letters initially
- Adjust cylinder axis and power with cross cylinder or let patient fine tune the axis while looking at the chart
- Consider **retinoscopy** to get a general idea: quality of red reflex, myopia, hyperopia, axis and power of astigmatism
Corneal Transplants: Months to Years Out

• Determine if **selective suture removal** may be indicated
  – presence of sutures and high amount of astigmatism in corneal **topography** and / or refractive error
  – Usually initiated from 1(DSAEK) to 3 months **(PK)** after surgery

• Confirm presence of necessary **instrumentation** for suture removal

Educating the patient

• **CLARIFY MEDS**
• Advise no changing/stopping meds unless directed by surgeon
• Review signs and symptoms of **broken sutures, graft rejection**
• **Avoiding all trauma** (even minor eye trauma can be serious with PK's)
• Optimizing tear film with topical **lubricants**
• Appropriate **follow-up** and dialogue with doctor’s office critical

While reviewing medication lists with patients can be a daunting task, it is crucial to successful treatment.
Telephone Triage

- What to do when a transplant patient calls in with a **new complaint**
  - **Understand** the patient’s symptoms
  - **Confirm** with the patient that you have clearly understood their complaint by repeating what they told you, in **laymen’s terms**.

Inquire about worrisome symptoms

- Has the patient’s **vision changed**?
- Is the eye **painful**?
- Are they **light sensitive**?
- Is the eye **red**?
- Was there a traumatic **injury**?
- Is the eye **tearing**?

http://www.nhs.uk/conditions/red-eye/Pages/Introduction.aspx
Past Ocular History

• What type of surgery did they have?
  – Clarify if they had a transplant
• Did they have a PK, a DSAEK, or other “Partial thickness” in laymen’s terms
• When was the surgery?

Past Ocular History

• Was the surgery complicated?
• Are they using the drops prescribed by their doctor?
  • If no, then why not?
  • Has the patient had any stitches removed?

Here’s a picture of the typical noncompliant patient
Urgency of Evaluation

- Transplant patients with keratitis symptoms* should be seen sooner rather than later
  - Especially PK patients
  - Higher incidence of rejection
  - Broken sutures are more common and a bigger problem when they occur
- If in doubt regarding urgency of evaluation, ask the MD
- Educate other medical professionals on the potential

Keratitis symptoms: Pain/foreign body sensation, tearing, photophobia/light sensitivity, redness, +/- blurred vision

So tell them they need to hurry and get in…

Non-Transplant Corneal Surgery

- Pterygium Excision
- Epithelial Debridement
- Corneal Culturing
- PRK / LASIK
- Cataract Surgery on Cornea Patients
Epithelial Debridement

- Debridment can be performed with sterile weck cell sponge or blunt instrument
- Helpful to use an eyelid speculum
- Generous topical anesthesia
- Bandage Contact Lens

Corneal Culturing

- For severely infected appearing eyes
- Topical anesthesia
- Culture plates
- Kimura spatula or Calcium alginate swab
- Eyelid speculum
- Complete paperwork and send to microbiology lab
Pterygium

• Early post-op
  – Interval history, symptoms, medications
  – Visual acuity with or without correction
  – Confirm eye drops
  – Presence of BCL
  – Suture removal usually at 2 wks

• Late post-op:
  – Signs or symptoms of recurrence?
  – Corneal mapping / measurements
  – Manifest Refraction

PRK / LASIK

• Similar procedures, similar goals
• Early post-op
  – Interval history
  – Symptoms: pain, foreign body sensation, light sensitivity
  – Visual acuity uncorrected
  – PRK: BCL
• Late post-op:
  – Interval history
  – Symptoms, dry eye symptoms and testing (Schirmer’s)
  – Visual acuity uncorrected
  – Corneal mapping, MRx, CRx, manual keratometry
Cataract Surgery after corneal surgery

- Records from prior refractive surgery
- Old glasses or contact lens prescription
- Documented patients goals or desires with cataract surgery
- Up to date corneal mapping and measurements
  - Topography
  - Tomography
  - Endothelial Cell Counts
  - Anterior Segment OCT
  - manual keratometry
- Manifest Refraction
- Biometry
  - Lenstar or IOL master for Axial Length and Keratometry

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Thanks for your attention!!

• Questions?